MAKING PRIMERS:
THE "PRIME ALL" KIT
PURCHASED, TRIED, APPROVED, ANALYZED, AND CRITICIZED

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First Publication: July 18, 2025
Revisions: January 26, 2026
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INTRODUCTION

It is clear that interest in reloading spent primers has grown in recent years. Several factors play into this phenomenon, but the core cause is certainly anxiety about the availability of ammunition. Hunters and sport shooters have become increasingly aware that reloading, in the conventional sense, is not a solution to the problem of ammunition scarcity. If ammunition becomes unavailable, it follows that the elements from which it is made will also become unobtainable.

Considered in a in a realistic light, reloading is an ideal way of creating the loads we would like to have, adjusted to the idiosyncrasies of our individual weapons and matched to the particular shooting sport we pursue. Reloading provides options to the marksman, freeing him from dependence on a narrow range of factory manufactured ammunition. But if there is no

ammunition at all, it is unlikely that reloading will bring an adequate supply back. If we consider the entire manufacturing process from start to finish, if powder, brass, primers and projectiles are available for sale to the public, then it would seem that factory assembled ammunition should also be on offer. If the factory made product has disappeared, this suggests that its individual components have also vanished.

It is my humble opinion that a large segment of shooters now view the matter in this way, and are seeking greater control over their supply of ammunition components. This concern has been recognized by merchandisers who would turn shooters' desire for a steady supply of ammunition into a business. This article will focus on the issue of primer scarcity, and the efforts of certain suppliers to sell to the public those basic materials from which primers are made. The merchants who offer the raw ingredients of primer fillers also send instructions to their customers, giving advice on compounding the chemicals they supply, and detailing techniques for loading impact sensitive mixtures into spent primers.

Trying It Out

Out of curiosity, I recently ordered a primer reloading kit, (perhaps more correctly called a "recharging" kit) sold under the name of "Prime All." When my order arrived, I found the package to contain a small plastic bag of white powder, a small bag of yellow powder, a third bag of black powder, a plastic scoop with a miniature measuring cup on each end, a dropper bottle filled with a turquoise colored liquid, a miniature funnel made of clear plastic, and an instruction sheet covering the recharging of Boxer type primers. In other words, one begins with fired primers of the type that contain separable anvils. These anvils are often shaped like small sheet metal shamrocks.

As described by the vendor, the combination of the four supplied ingredients results in an impact sensitive explosive material. If properly compounded, it should generate enough heat to ignite any common propellant, be it black powder or one of the many varieties of smokeless powder. It would therefore be suitable for refilling spent primers.

The most striking thing about these materials is that none of them were identified by their ordinary chemical names, though they clearly must be reagents available through chemical supply houses. I took it for granted that these mystery substances qualified as "technical grade" materials, which is the designation appearing on the chemicals I purchase from pyrotechnic dealers. That is to say, they are not as scrupulously pure as materials labeled "pharmaceutical grade," but are superior in quality to the raw chemicals sold in bulk for agricultural purposes.

Before recharging spent primers, it is first necessary to separate the anvils from the cups, straighten out the cups by flattening the dimple left in them by the firing pin, and clean all these components scrupulously. In this way, I prepared twenty primers for recharging.

I want to do justice to this product, and carefully followed the instructions supplied. Using the measuring tool provided, I placed two large scoops of the white powder, one large scoop of the yellow powder, and one small scoop of the black colored powder in a small plastic mixing cup. Following the supplied instructions I mixed them thoroughly with a small wooden paddle intended for use with paint pigments, removing all of the lumps until the mixture became an even gray color. I then proceeded to charge a dozen of my prepared large rifle primers, assembling the primer cup and anvil combination as instructed, and finished each primer off with a drop of the mysterious turquoise liquid.

I left the primers to dry for several days before assembling them in cartridges, installing them as I would any other new, commercially manufactured primers. To sum it up in simple words, they worked. In fact, the finished ammunition functioned quite well from the standpoint of accuracy. I think much of this is due to the fact that I used new, very high end brass and high quality Hornady bullets to create middling velocity .30-06 rounds. And the primers did what they should do, reliably igniting the powder.

From this experience, I must conclude that this product is sound. However, it is also a candidate for almost infinite improvement. But to explain my proposed improvements, I must provide additional information on primer technology.

I have been experimenting with pyrotechnics, black powder, and impact sensitive explosives for more than 50 years. My earliest forays into this branch of chemistry taught me many lessons, which are now engraved in my body in the form of deep scars. I would not call these injuries a loss, because I can now display them when instructing my grandsons in the art and science of chemistry. In addition to modifying my person in curious and novel ways, I also uncovered every priming composition ever used in the manufacture of small arms ammunition, and pretty much know all the formulas by heart.

Priming compositions fall into two basic classes: those based solely upon sensitive high explosives such as tetracene, TNT, lead styphnate and various modifications of nitrocellulose. None of the materials contained in my recently purchased kit bear any resemblance to these hazardous substances. The second class of primers consists of those which contain some quantity of potassium chlorate, a compound which yields an impact and friction sensitive product when mixed with sulfur, or sulfur bearing compounds.

As noted, some primer mixtures exclude chlorates, deriving all their energy from high explosives and other ingredients, and these are typically characterized as "noncorrosive." It is

also possible to achieve completely reliable ignition using only potassium chlorate, mixed with a suitable fuel. The fuel is almost always sulfur or a sulfide. Any formulations which include any quantity of chlorates are censoriously called “corrosive primers.”

Permit me to caution the reader that I do not believe that any primer composition, whatever it may be called, can be absolutely “noncorrosive.” The same observation can be made concerning our propellants. The important point to bear in mind is that any primer containing any quantity of chlorate will initiate vigorous corrosion, which commences soon after firing, and will be even more aggressive if ambient humidity is high. Always clean your firearms, but if you are using corrosive primers, clean as soon as you are finished shooting with a solvent suitable for black powder. I still believe in soap and water for this task.

The priming mixture produced with my Prime All kit is indisputably a chlorate based, impact sensitive explosive. This can be inferred from the fact that it contains nothing that looks, smells or reacts like any of the high explosives which have been mixed into primers over the years. Even without the ability to identify these hazardous materials, the fact that this kit can be shipped in interstate commerce, and the fact that the vendor is not in federal prison is, all by itself, potent circumstantial evidence that it contains no tetracene, TNT, or other similar energetic materials.

When we use this kit, we are manufacturing ordinary corrosive primers of the old style, the breed of primers that was used by the United States military through 1946, or thereabouts. The literature on this topic provides a number of formulas which have been successfully employed in commercially manufactured ammunition.

A typical chlorate based primer composition is given in the well known work of Dr. Tenney L. Davis, *The Chemistry Of Powder And Explosives*, (John Wiley And Sons, Inc., New York, 1943) On pager 456 of that work, the following formula is stated:

Potassium Chlorate: 50.54 %
Antimony Sulfide: 26.31 %
Sulfur: 8.76 %
Ground Glass: 12.39 %
Shellac: 2.00 %

(All measurements given by weight)

The exact role of the ground glass in this recipe is unclear to me. It has always been my assumption that the ground glass is added to sensitize the composition by adding an extra element of friction to the impact of the firing pin. For reasons which are also unclear to me, various authors prescribe the addition of borosilicate glass, and caution against the use of

other varieties. In my own work in this field, I have never added any type of glass to a primer mixture, and have enjoyed success even in its absence. For those who wish to experiment with powdered glass, I note that various forms of it are offered for sale online, including the borosilicate variety.

The shellac is incorporated into this mixture as a binder, since the other ingredients are not self-adherent and require a “glue” to hold them together. When dry shellac is incorporated with the other powdered ingredients as a dry mix, the shellac’s qualities as a binder are activated after the primers are loaded, by placing a small drop of alcohol in each primer. Once the alcohol has dried, the plasticized shellac hardens and encases the other ingredients, forming them into a solid pill which is not easily broken.

A very similar formula is mentioned by ammunition expert George E. Frost in his book *Ammunition Making* (National Rifle Association Of America, Washington, D.C., 1990). On page 48, Frost notes that many years ago, the Army found the short life of fulminate primers unacceptable, and changed to a formula made up of sulfur, potassium chlorate, and antimony sulfide. He does not specify the proportions of these ingredients, but the basic formula is the same as that provided by Davis.

It goes without saying that the formula revealed by Davis and Frost is corrosive, and corrosive to a very high degree. Potassium chlorate combusts to form potassium chloride, the near cousin of table salt, and after a day of firing chlorate based primers, the bore of a weapon will be well coated with an aggressive substance prone to absorb water. This will produce an almost ideal etchant, and any weapon which must digest such a mixture will require thorough cleaning on the same day it is used. I will repeat that soap and water is an ideal cleaning solution for such ammunition.

Thus far, I have neglected to mention the potential injurious effects of mixtures containing both chlorates and sulfur. Anyone who has received formal instruction in the craft of pyrotechnics will be aware of the dangers inherent in mixing these two substances. The combination is notorious in the pyrotechnic trade for producing spontaneous combustion in fireworks, as atmospheric air can cause sulfur to degrade into sulfuric acid. Sulfuric acid produces combustion upon extended contact with chlorates, making such a mixture uniquely unpredictable and dangerous.

The common solution to this danger is to add a very small quantity of antacid to pyrotechnic mixtures in which potassium chlorate and sulfur are both present. Interestingly, Davis notes that the "souring" of chlorate/sulfur mixtures can cause primers to become insensitive to impact. In the absence of antacids such as sodium bicarbonate, a chlorate and sulfur mixture suffers from two serious defects: potential spontaneous combustion and potential insensitivity to the impact of a firing pin.

Another solution to the "souring" problem, as adopted by the pyrotechnic trade, is to substitute potassium perchlorate for potassium chlorate in pyrotechnic mixtures. However, I have no personal knowledge concerning the impact sensitivity of potassium perchlorate mixtures; in pyrotechnics, we are concerned with the brilliant colors produced by perchlorates and chlorates, which are equal in their power to produce visual effects. Without additional controlled experiments, I would not count upon potassium perchlorate as an effective substitute for potassium chlorate.

The True Identity Of The Unidentified Ingredients

So what are the unnamed ingredients contained in the Prime All recharging kit?

The kit delivered to me bears no notice of a patent claim, and the seller's coyness about revealing to me what I purchased is convincing proof that the ingredients supplied are common and very inexpensive. Perhaps the enterprising vendor wants to maintain the identity of these materials as a secret. In the case of impact sensitive priming compounds, this aspiration must be disappointed by those who have a knowledge of pyrotechnics and are willing to practice a little "reverse engineering."

I am confident that the white powder supplied with this kit is potassium chlorate. It is the obvious choice for a primer compound which lacks the high explosive components previously mentioned. I frankly admit that I have not placed these materials in the hands of an analytical chemist to puzzle out their true nature, but I do not think that I must go to this expense to know what I have.

The bag of yellow powder is likewise no mystery, because upon opening it I immediately detected the smell of sulfur. If the vendor has given me a good product, this is almost certainly the high quality version known as "rubber maker's sulfur," the acid-free variety favored in pyrotechnics and for the vulcanization of rubber.

A greater mystery is the nature of the black colored powder. My initial impulse was to think that this material is finely pulverized antimony sulfide, but there are several problems with this conclusion. When I compared the black substance from my kit with a high grade sample of antimony sulfide from a chemical supply house, I noted some slight difference in appearance. The material in my kit has a shiny quality to it, reminiscent of the reflective surface of clean anthracite. By contrast, my sample of antimony sulfide has a grayish quality, and in my judgment appears slightly duller, though not by much.

The second, most decisive difference between the black mystery powder and antimony sulfide is their difference in flammability. I placed a sample of finely powdered antimony sulfide on a

piece of white index card and set the edge of the card alight. When the fire reached the antimony sulfide, nothing happened. The card burned away around the sample, and dumped the antimony sulfide on the fire brick base where I perform such tests.

Some of my correspondents have proposed that the black powder is charcoal. Allowing that this could be true, I repeated the “index card test” and found that my small pile of pyrotechnic charcoal smoldered slowly, like an incense stick.

When I put my mystery black powder to the test, the sample burned vigorously in a way similar to a sparkler, emitting a flash of crackling sparks, little meteors which appeared to explode at the apogee of their travel. The whole mass of my sample was consumed very quickly. It bore no resemblance to antimony sulfide, nor to charcoal.

If I wanted to create this visual effect for purposes of a pyrotechnioc display, there is one and only one material I would count on to replicate it: titanium. 325 mesh titanium is available from pyrotechnic supplies for the purpose of creating exactly the sparking phenomenon generated by my mystery powder, and the addition of it to a primer mixture is right in the noble tradition of historical primer mixtures.

Many treatises that cover priming compounds advocate the addition of pulverized metals to these mixtures as a means of generating sparks, which enhance the primer's ability to communicate heat to the powder. Some writers advocate the addition of aluminum, others prescribe heavier metals and lead compounds. I think titanium to be a good choice for this role, because it burns at a very high temperature, and the sparks generated by 325 mesh titanium are known for their endurance, that is, their ability to leave long spark trails when incorporated into display fireworks such as star shells. For this same reason, books on military pyrotechnics advocate the use of titanium powder in kindling fuses and other applications where a high heat of ignition is required to set off detonators..

Because the primer mixture contains elemental sulfur, I would also note that sulfur mixed with a metal powder is itself, without more, a recognized propellant. These mixtures can usually sustain burning inside a closed vessel, even in the absence of the oxygen provided by potassium chlorate. Of course, it is the chlorate which renders our primers impact sensitive, and also ensures that the three-part mixture burns with an intense flash.

To move my conclusions from the realm of conjecture to the category of fact, I combined a substantial quantity of sulfur from my kit with a like volume of this black powder, which I supposed to be titanium. After mixing these ingredients well, I set fire to the mix and observed it to burn quickly, like a slow burning gunpowder, and in a way very similar to a 50/50 mixture of sulfur and zinc. This latter formula was once a favorite of amateur rocket experimenters, and gives a consistent but low powered impulse to small rocket engines. This experiment

confirmed in my mind that the mysterious black powder is indeed an elemental metal. Given the sparks it produces, I am compelled to conclude it is titanium.

Titanium powder is readily available from pyrotechnic supplies, as well as from suppliers of materals used in 3D printers. It is offered in 325 mesh form, at affordable prices, and can perform the function required of a metal powder included in a good primer composition.

The last ingredient remaining to be identified, the “mysterious blue distillate,” is really less problematic. It is a binder of some sort, and the list of primer formulas is replete with all sorts of binders, all of which work to keep the primer pellet intact. The fact that it is blue is very sensible; first, it makes it look mysterious, another piece of the impenetrable magic of our kit. Second, and more practically, the color lets us know if we have remembered to add it to our primers. The violently cerulean color shows up in the primer cup after it dries,

Rather than attempt to determined exactly what goes into this liquid hardener, I will instead refer to the wide range of choices drawn from many primer formulas. But first of all, let me note that the blue liquid provided with the kit is probably a water-based compound, because it lacks the odor of alcohol, toluene, or any of the other aromatic solvents often found in primer hardeners. But even if we confine ourselves to only water based hardeners, we can still choose from an enormous range of possibilities, most of which work.

Davis, in *The Chemistry Of Powder And Explosives*, (Vol. 2, p. 455,) mentions several binders for primer compositions, among them water with gum arabic, and water with gum tragacanth. Frost, in *Ammunition Making* (p. 58) gives an exact formula for a very large quantity of water-based composition:

Gum Tragacanth	100 grams
Gum Arabic	50 grams
Gelatin	10 grams
Thymol	1.5 grams
Water	1.9 liters

The water is heated to 75 degrees C, and the gum tragacanth, gum Arabic and gelatin are added to it, keeping the temperature constant for three hours. The mixture is left to cool, and once it has come to room temperature, the thymol is dissolved in 15 mL of alcohol and added to the cooked solution. The thymol serves as a preservative, but Frost notes that even with this addition the binder solution will only last about two weeks, if refrigerated.

If we intend to use a water based binder, it is my humble opinion that a freshly mixed batch of 5% gum Arabic solution will give a satisfactory result. This is the binder typically used in match heads, the friction primers on flares, and for binding an illuminating mixture to sparkler wires. If

a better and more waterproof binder is desired, the literature on pyrotechnics is filled with binder solutions based on denatured alcohol, in which various alcohol soluble plastics can be used to solidify all sorts of powders. I believe that more durable primers could be produced with these alcohol-based binders, but their use cannot be briefly described, and this subject requires an entire article by itself.

No matter the binder formula we choose, we are at liberty to tint it any color we wish.

Does It Have Other Ingredients?

Prime All may contain additional materials, beyond the potassium chlorate, sulfur, and titanium I have identified. The addition of small traces of certain other ingredients would be advantageous to the consistency and functioning of the primers produced with it.

I have already established that potassium chlorate is present in this mixture, along with sulfur. This being the case, it would be highly desirable to add an antacid to the mixture, to prevent the "souring" of sulfur in the presence of chlorate. As noted earlier in this article, this measure would obviate dangers: the deactivation of the primer, and the danger that the priming mixture could spontaneously ignite. It is also *possible* that the white powder included in the kit contains potassium perchlorate, rather than potassium chlorate, in which case the antacid would not be required.

A simple and effective antacid for chlorate/sulfur mixtures is sodium bicarbonate, something, cheap, safe to handle and effective. Buy be cautioned: the effectiveness of any antacid depends upon how thoroughly it is incorporated into the pyrotechnic mixture. Later, I shall explain why I think mechanical incorporation of priming ingredients to be superior to manual combination.

It also seems likely that one of the three powders provided in this kit has a certain amount of binder material mixed in with it. The instructions provided with my kit contain the remark that the blue liquid serves as an activator for binding the mixture, meaning that the binder must be present in at least one of the other three ingredients. Since I believe the turquoise liquid is a water-based solution, the binder used in prime all could be something as simple as a small quantity of gum arabic mixed in with the primary powdered ingredients.

A Question Of Proportion

Of course, a recipe is meaningless if it does not specify the quantity of each required ingredient. As noted at the beginning of this article, the Prime All kit I purchased includes a double ended measuring scoop, and specifies the proportions of each ingredient by quantity, and not by weight. This provision is adequate, because the mixture produced functions

effectively, but it is highly desirable that any chemical mixture be compounded by weight, and not by volume.

I used an RCBS balance-type powder measure to weigh the prescribed volumes of potassium chlorate, sulfur, and titanium, and obtained the following results:

Potassium chlorate: 3.0 grains
Sulfur: 1.5 grains
Titanium: 3.0 grains

Therefore, by mass, the Prime All priming compound consists of 40% potassium chlorate, 20% sulfur, and 40% titanium powder, not taking into accountant any weight attributable to traces of a binder and an antacid.

To be quite clear, I weighed out a number of samples of these materials, using the scoop provided. The masses stated in the foregoing formula are the averages around which these samples clustered. A variation in the masses detected was noted, and was clearly connected to how tightly I packed the scoop when I ran it through the powdered ingredients. If measuring by volume, especially with a small scoop, there is a high risk of leaving small air pockets in the material measured. For consistency and predictability, it would be far better to measure these ingredients with a precision balance.

However, requiring the purchasers of Prime All to own a precision balance would undoubtedly inconvenience many customers, and discourage a certain number of would be buyers from even trying it. It is therefore sensible economics for the seller to work out a formula where measurement by volume yields a mixture that is *good enough*. If it ignites the powder in our cartridges, it has done its job.

Doing It Better: Seven Problems And Seven Possible Solutions

Prime All is a good product, but deficient in several ways.

First and foremost, one must find fault with the vendor's failure to identify the ingredients. They are effective for producing primers but potentially quite hazardous, even when not combined. I focus particular attention upon the potassium chlorate, which is a material that will both initiate the process of burning, and will always accelerate a fire. If it is accidentally combined with any carbonaceous material, including dried out foodstuffs or sawdust, friction can set it off. It will also ignite in contact with acidic materials, including such things as the scale and build up that forms around the poles of car batteries.

If the product contains potassium perchlorate, a few of our concerns would be alleviated, but many would remain.

The titanium is also an issue of concern to me, as I have used many powdered metals in the course of my employment, and in the enjoyment of my hobbies. All of them, even in small quantities, can spontaneously ignite if not well sealed in airtight containers. To leave them in proximity to a powerful oxidizing agent like a chlorate does not strike me as a sound practice.

The chemicals sold in the Prime All kit should be labeled with their proper scientific names, and each ought to be accompanied by a Material Safety Data Sheet. Thus, minimal caution would permit the purchaser to investigate the properties of the ingredients, and take meaningful safety measures when storing and using them.

Second, the provision of a single plastic measuring device invites the cross-contamination of the materials in the kit. The kit should contain a single plastic measuring spoon for each chemical provided, along with instructions to carefully wash the spoons between uses. As the kit is now set up, each separate chemical could easily end up contaminated with quantities of the other two materials, a situation which is scrupulously avoided in all academic and industrial laboratories. This is both a quality issue and a matter of safety.

The third concern relates to the quality of the finished product. The instructions do not contain any measurements based upon weight, but direct the user to prepare the priming mixture by scooping out tiny volumes of each ingredient. As previously noted, the actual quantity of each chemical is difficult to control, as evidenced by the varying weights measured out when multiple samples are taken.

The proper approach to compounding any consistent mixture of solid materials is always combination by weight. In order to produce the same power of ignition in each and every primer, the same mixture must go into each and every one. That is, the ratios of basic ingredients can never vary from primer to primer, and one way of securing this desirable result is to make the priming compound absolutely consistent. Process control and repeatability are paramount if one is to produce reliable primers.

It is unfortunate that the customers will be put to the expense of securing a sensitive scale, but there is just no other way to obtain the best possible product save by weight measurement.

The fourth point of concern is the haphazard method of mixing the components of the primer compound. This may sound controversial, but it is my opinion that they must be measured out by weight and then mixed mechanically to a level of integration that is impractical to achieve by hand.

After long experience mixing friction sensitive and impact sensitive pyrotechnic products, I am here to testify to one abiding truth: if you work with them over a long period of time, you will

experience unintended ignition at some point. Whether you are injured by this depends entirely upon where you are located when the unanticipated event occurs.

Mixtures of the type produced with the Prime All kit will inflict serious burn injuries. After all, the reason for their manufacture is to produce heat, and to communicate that heat to other energetic materials. Therefore, holding a priming mixture and agitating it with a stick or spoon is to invite burns on your hands.

Materials can be easily mixed and refined to a high degree of incorporation by placing them in a slowly rotating cup, made of wood, with a one and one half inch diameter lead ball present as a crusher. The cup should be open at the top, and slanted at about forty degrees from the vertical position, such that the mixture and the crusher ball travel in a rounded track near the bottom of the vessel. This mixing machine should be placed outdoors, with a very lightly fitting wood or rubber cover to keep out debris.

A small low speed motor can be purchased for a modest price on Amazon or eBay. I have purchased several of these over the years for less than $25, and have succeeded in finding many reliable specimens that turn at a rate of 15 to 25 rpm. Wooden cups to match these motors can be located from the same sources, and mounted directly to the shaft of the motor with a piece of plastic tubing epoxied to the base of the cup.

In a set up of this type, the priming mixture can be turned for a period of 8 to 12 hours, and when the mixing is completed it will prove to be absolutely uniform and very sensitive. Your only interaction with the priming mixture will be when loading your mixing machine and when removing the completed priming compound. When you are close to the mixture, it is very important that you wear (at the very least) a polycarbonate face shield and leather gloves. More personal protective gear would not be a bad idea.

In my experience, most pyrotechnic mixtures based upon potassium chlorate will burn with a sudden intense flash, but do not detonate. The exception I have observed is a mixture containing chlorate and a finely pulverized metal powder. This will burn with a flash in very small quantities, but at certain levels of mass it will "self contain" and produce a detonation, even if it is not enclosed. In the case of chlorate or perchlorate mixed with 5 µm aluminum, most authors on the subject of pyrotechnic safety exhort us to be cautious when the mass of the mixture approaches 10 g. I would certainly not bet my life or the integrity of my body on their judgment. 10 grams of aluminum based flash powder is a formidable explosive charge.

In the case of a potassium chlorate/sulfur/titanium priming mixture, I would not hazard a guess about what amount constitutes a critical mass. My *unjustified and factually unsupported hunch* is that we are safe if we work with one gram or less at a time.

Bear in mind that this priming mixture will go off unexpectedly if you fool around with it enough. This is my promise to you. What happens when it misbehaves will depend entirely upon where you are located when it chooses to do so. If you have reduced the danger to yourself by mixing this material in a small mechanical device, you must resign yourself to the probability that your cute little machine will someday be wrecked. When this happens, you can take great satisfaction in the fact that you were observing it from afar.

Keep the amounts small. The instructions provided with the Prime All kit provide for the preparation of about 7.5 grains of this substance, approximately half a gram. Even this small amount could inflict a very painful burn, and none of us want that.

The fifth problem I see with the Prime All kit is its failure to provide any means of placing exactly the same mass of priming compound in each and every primer. Of course, if a measuring device were provided to give all primers a more nearly equal mass of the priming mixture, our kit would cost $40 rather than $20.

The best way of securing repeatability in each primer would be to weigh each and every charge on a scale. I have no doubt that this is done by the ammunition factories through the use of charging devices that detect mass electronically and dispense it mechanically. Probably the next best way of achieving uniformity of charging is by a volumetric device, which can deliver results very close to uniformity, even if not equal to a robotic weighing and charging system. I can suggest several ways of constructing this type of device.

The simplest expedient would be to place the primer cups in cubbyholes, drilled to uniform diameter and depth in a plate. I believe a Delrin plate would be ideal for this purpose. The plate holding the cups would sit beneath a second plate which exactly matched it, the upper plate being perforated with small holes sufficient to contain the desired charges of primer material when completely full. The upper plate should be so constructed that, when the edges of both plates are exactly aligned, the material trapped in the upper plate would be free to fall through the calibrated measuring holes and down into the primer cups. When charging the upper plate with primer material, it could be slightly offset from the lower plate holding the cups, the lower plate thereby acting as a block until both the upper and lower units are exactly aligned.

This is only a suggestion for one possible solution. But have I not already condemned a process that approximates mass by use of, volumetric measurement? I confess guilt!

In my defense, I can only plead that any charging system which measures by volume will be greatly facilitated by the use of a priming compound that has been very finely and uniformly ground. Any mixture that is lumpy, irregular in its granularity, or in which the components are not uniformly distributed, will be less than optimal when it's mass is being approximated by

measuring its volume. The situation is improved when the components of the mixture are completely integrated, completely dry, and thereby made free flowing.

At this point, I should note that great benefits may be enjoyed if we force dry all of our components before blending them. This expedient does not seem necessary in the desert climate where I live, but is probably required if you live in a humid area.

The sixth issue that comes to mind is the fact that the instruction sheet contained in the Prime All kit fails to mention that the product is seriously corrosive. I devoutly hope that anyone who uses Prime All will become aware of this fact before using it in the ammunition he intends to fire in a high value weapon. Ignorance of this fact, and failure to thoroughly clean such a weapon with an appropriate solvent, could lead to severe disappointment and even worse financial loss.
Prime All is no worse than any other late 19th century or early 20th century priming mixture, but the availability of less corrosive ammunition has taught many of us to be lax about cleaning our weapons. Do not neglect your cleaning routine when using this product.

My seventh and last gripe about prime all is one that may not be fixable. When using this product as instructed, we must never forget that this priming compound is being applied to primer cups that have already been struck and deformed at least once. To make a reliable primer out of the used item, it is necessary to flatten out the dimple left by the firing pin. This leads me to consider the issue of metal fatigue, and what might be expected to happen with such a "restored" primer when it is placed behind a high intensity load. What is the chance that it will give way and create the grave effects which a ruptured primer can produce?

It comes to my mind that even fresh factory primers can give way, and I have seen it happen in one instance where an acquaintance of mine, shooting a bolt action hunting rifle of good quality, had the right side of her face and the area directly beneath her right eye blown through with tiny fragments of brass. In short order, the brass beneath her skin began to discolor, creating the appearance of massive bruising. Fortunately, the manufacturer of the ammunition took responsibility for the accident and paid a truly heroic sum of money to provide her with the plastic surgery she needed.

There is a second, similar concern regarding the effects of prior firing on the anvil in a spent primer. When Boxer primers are initially loaded, the anvils placed in them are indented to form a point that faces backwards towards the base of the cup, and creates a pinch point between the surface of the cup and the anvil. Is this pinch point modified by a deformity induced in the anvil when the primer is fired? I did not detect such a problem with the primers I recharged, but my little test of my Prime All kit did not yield a statistically significant sample. A deformed anvil could prevent a primer from discharging, but this would be of less concern than a primer cup which ruptures.

These problems of possible primer rupture and anvil deformation are not simply solved. The real solution for this problem would be for the fabricators of primers to make, or otherwise obtain, accurate and repeatable blanking dies and cupping dies, with which to produce fresh anvils and cups. This would have to be done using blanking stock of the proper composition and thickness, treated to the right material condition. The material requirements can be determined, and I believe that Frost deals with the subject in *Ammunition Making*. But now you are not just a recharger of spent primers, but a primer manufacturer!

CONCLUSION

The Prime All product is one of the more innovative offerings I have seen in a long time. The concept behind it meshes nicely with my overall philosophy that we should strive to become a community of self-sufficient and independent craftsmen. However, as you will discern from my short article, abundant care and attention must be invested in order to produce primers that are anywhere near as reliable and safe as those provided by commercial manufacturers. Prime All is a solution to the problem of primer scarcity if you are leading a cell of the French resistance, or a Taliban commander setting up ambushes in the Hindu Kush. For our purposes, the most practical solution to the problem of primer scarcity is to buy them up when they are available, and keep an enormous quantity of them in reserve for the day when they truly disappear.

This does not mean that the knowledge communicated by Prime All is insignificant; in fact, it should be broadcast, studied, improved, evaluated, and improved again. This would be a good thing to do if you have an abiding interest in the formal study of pyrotechnics, especially its safety aspects, and are willing to incorporate that knowledge with other technology, such as machining, quality control, and basic chemistry. I would feel better if we had many people around competent in these areas and capable of manufacturing high quality primers when called upon to do so.

At the same time, I have witnessed too many accidents caused by untrained hobbyists working with the very same chemicals included in the Prime All kit. Two lethal accidents of this sort occurred in my hometown, one in 2001 and the second about three weeks ago, in June of 2025. In both cases, the homes of the errant experimenters were simultaneously blown to pieces and burned up. And of course, I will not forget the painful injuries I suffered as an adolescent when tinkering with pyrotechnic toys.

It is my considered judgment that Prime All is useful, because it teaches us what can be accomplished if we are forced by circumstances to adopt rather extreme expedients. I cannot recommend that the untrained and the incautious try this product out, because of the dangers associated with the handling of any pyrotechnic mixture. For those who are both correctly trained, cautious and experienced, the kit I purchased exemplifies a process that could be

improved and standardized. But before my expertly trained and scientifically educated readers order a batch of Prime All, they should read the biographies of the many intrepid men and women who preceded them, and now repose under monuments which honor their ultimate sacrifice.